CLAIMS

What is claimed is:

1. A method of extracting information from a plurality of transmitted chirp radio frequency waveforms comprising the steps of:

receiving a plurality of chirp radio frequency waveforms;

removing noise from said received chirp radio frequency waveforms; and

5   extracting information from said received chirp radio frequency waveforms after said noise is removed.

2. A method as recited in Claim 1, further comprising the step of conditioning a plurality of intermediate frequency pulses which result from the removal of said noise to form a square wave digital output that correlates with said transmitted chirp radio frequency waveforms.

3. A method as recited in Claim 1, in which noise is removed from said chirp radio frequency waveforms using a Kalman filter.

4. A method as recited in Claim 1, in which the step of extracting information from said received chirp radio frequency waveforms after said noise is removed includes the following steps:

down converting said chirp radio frequency waveform by subtracting f_o from said chirp radio frequency waveform to produce a series of U and D or UD and DU pulses containing frequencies between 0 and Δf;

sending said series of U and D or UD and DU pulses to a frequency-to-voltage converter; and

differentiating the resulting triangular shaped pulses to produce square pulses, positive for the U chirp and negative for the D chirp.

5. A method as recited in Claim 1, in which the step of extracting information from said received chirp radio frequency waveforms after said noise is removed includes the following steps:

determining the zero crossings of received chirp radio frequency waveform; and

measuring and comparing the zero crossing intervals to the known patterns for U/D or UD/DU chirps.

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6. A method as recited in Claim 1, in which the step of extracting information from said received chirp radio frequency waveforms after said noise is removed includes the following steps:

measuring the first and last zero crossing intervals for U/D; and

5   measuring the first and middle crossing intervals for UD/DU.

7. A method as recited in Claim 1, in which the step of extracting information from said received chirp radio frequency waveforms after said noise is removed includes the following steps:

integrating said chirp radio frequency waveform; and

5   determining the pulse value by evaluating the negative or positive integral that results.

8. A method as recited in Claim 1, in which the step of extracting information from said received chirp radio frequency waveforms after said noise is removed includes the following steps:

rectifying said received chirp radio frequency waveform;

5   integrating said received chirp radio frequency waveform to give said received chirp radio frequency waveform a pulse corresponding to a "one" pulse.

9. A method as recited in Claim 1, in which the step of extracting information from said received chirp radio frequency waveforms after said noise is removed includes the following steps:

splitting said received chirp radio frequency waveform;

5   sending said received chirp radio frequency waveform to both a "one" comparison circuit and "zero" comparison circuit;

subtracting said received chirp radio frequency waveform from the appropriate known "one" chirp wave form;

rectifying and integrating the voltage difference;

10   subtracting said received chirp radio frequency waveform from the appropriate known "zero" chirp wave form; and

rectifying and integrating the voltage difference.

10. A method as recited in Claim 1, in which the step of extracting information from said received chirp radio frequency waveforms after said noise is removed includes the following steps:

splitting said received chirp radio frequency waveforms into a first signal and a second signal;

feeding said first and said second signals to a "one" comparison circuit and to a "zero" comparison circuit;

adding said first signal to an appropriate known "one" chirp waveform in said "one" comparison circuit;

rectifying the resulting voltage sum from the "one" comparison circuit;

integrating the rectified signal from the "one" comparison circuit;

feeding the integrated signal from the "one" comparison circuit to a first bistable device that is set to trigger at a voltage between two possible outputs;

adding said second signal to an appropriate known "zero" chirp waveform in said "zero" comparison circuit;

rectifying the resulting voltage sum from the "zero" comparison circuit;

integrating the rectified signal from the "zero" comparison circuit; and

feeding the integrated signal from the "zero" comparison circuit to a second bistable device that is set to trigger at a voltage between two possible outputs.

11. A method as recited in Claim 1, in which the step of extracting information from said received chirp radio frequency waveforms after said noise is removed includes the following steps:

adding said received chirp radio frequency waveforms to a plus chirp waveform;

5   rectifying the sum; and

integrating the rectified signal.

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12. A method as recited in Claim 1, in which the step of extracting information from said received chirp radio frequency waveforms after said noise is removed includes the following steps:

feeding said received chirp radio frequency waveforms through a non-overlapping

5   notch filter that covers the chirp frequency interval;

rectifying the output of said filter;

integrating the rectified signal;

conveying the integrated signal into an AND junction which is gated by a generated signal that is timed to the sweep of a chirp;

10   conveying the output of the AND junction into an AND gate array so that only if all of the frequency inputs occur in the proper order at the proper interval, a pulse corresponding to a "one" chirp is produced.

13. A method as recited in Claim 1, in which the step of extracting information from said received chirp radio frequency waveforms after said noise is removed includes the following steps:

feeding said received chirp radio frequency waveforms through a non-overlapping
5   notch filter that covers the chirp frequency interval;

rectifying the output of said filter;

integrating the rectified signal;

conveying the integrated signal into an AND junction which is gated by a generated signal that is timed to the sweep of a chirp;

10   conveying the output of the AND junction into an AND gate array so that only if all of the frequency inputs occur in the proper order at the proper interval, a pulse corresponding to a "zero" chirp is produced.

14. A method as recited in Claim 1, in which the step of extracting information from said received chirp radio frequency waveforms after said noise is removed includes the following steps:

downshifting said received chirp radio frequency waveforms from the base

5   frequency.

15. A method as recited in Claim 1, in which the step of extracting information from said received chirp radio frequency waveforms after said noise is removed includes the following steps:

splitting said received chirp radio frequency waveforms into N channels;

5 successively down shifting each of said channels by $f_o + k(\Delta f/N)$ using an oscillator and a frequency multiplier;

conveying the resulting signal through a notch filter with $\Delta f/N$ width, with k running from 1 to N;

rectifying and integrating the output of each channel; and

10 feeding the output of all the channels into a timed AND gate array so that only if all of the frequency inputs occur in the proper order at the proper interval is the output a pulse corresponding to a "one" chirp.

16. A method as recited in Claim 1, in which the step of extracting information from said received chirp radio frequency waveforms after said noise is removed includes the following steps:

splitting said received chirp radio frequency waveforms into N channels;

5   successively down shifting each of said channels by $f_o + k(\Delta f/N)$ using an oscillator and a frequency multiplier;

conveying the resulting signal through a notch filter with $\Delta f/N$ width, with k running from 1 to N;

rectifying and integrating the output of each channel; and

10   feeding the output of all the channels into a timed AND gate array so that only if all of the frequency inputs occur in the proper order at the proper interval is the output a pulse corresponding to a "zero" chirp.

17. A method as recited in Claim 1, in which the step of extracting information from said received chirp radio frequency waveforms after said noise is removed includes the following steps:

conveying said received chirp radio frequency waveforms to a filter whose output is linearly proportional to the frequency to produce a voltage signal whose magnitude is proportional to the input frequency;

passing said voltage signal through an envelope detector; and

differentiating the output of said envelope detector to produce square pulses of appropriate sign.

18. A method as recited in Claim 1, in which the step of extracting information from said received chirp radio frequency waveforms after said noise is removed includes the following steps:

conveying said received chirp radio frequency waveforms to a filter whose output is
5   linearly proportional to the frequency to produce a voltage signal whose magnitude is proportional to the input frequency;

passing said voltage signal through an envelope detector; and

using the output of said envelope detector to trigger a bistable device to produce positive and negative pulses.

19. A method as recited in Claim 1, in which the step of extracting information from said received chirp radio frequency waveforms after said noise is removed includes the following steps:

splitting said received chirp radio frequency waveforms into a first signal and a

5   second signal;

feeding said first signal to a delay element which introduces a delay Δt;

multiplying said delayed first signal by said received chirp radio frequency

     waveforms; and

feeding the product to an envelope detector to generate a signal that is proportional

10   to the chirp frequencies times the delay.